**Lecidea phaeophysata**: a new saxicolous lichen species from western and southern Europe with a key to saxicolous lecideoid lichens present on Atlantic coasts

Alan M. FRYDAY and Pieter P. G. VAN DEN BOOM

Abstract: The new lichen species *Lecidea phaeophysata* is described from rocks close to the coast in Italy, Portugal, France and Ireland. Distinguishing features include *Porpidia*-type asci and simple paraphyses that are fuscous brown pigmented in their upper section. Its systematic position is discussed but is unclear as molecular data are lacking (all collections are c. 20 years old). Therefore, we chose to describe the species in a broadly-circumscribed *Lecidea* rather than erecting a new monotypic genus. A key to saxicolous lecideoid lichens present on Atlantic coasts in Europe is also provided.

Key words: Bryobilimbia, coastal habitat, Lecideaceae, Porpidia-type ascus, taxonomy

Accepted for publication 16 December 2018

Introduction

The lichen biota of Western Europe is probably better studied and understood than any other region worldwide but collections of apparently undescribed species still occur with surprising regularity (e.g. Fryday & Coppins 2012; van den Boom et al. 2017). Among these are five collections of a novel saxicolous species, made between 1993 and 2001 in maritime areas of the Atlantic and Mediterranean coasts from north-west Italy to western Ireland. The new species could easily be mistaken in the field for a species of *Porpidia* Körb. but it is microscopically very distinctive because it possesses simple paraphyses that are pigmented in the upper 10–25 μm. As this combination of characters is unique, we also suspect that these collections represent a distinct lineage. However, as molecular data are lacking, we chose not to erect a new genus but instead to describe them in a broadly-circumscribed *Lecidea*.

Materials and Methods

This study was based on specimens collected by the second author and by Maarten Brand (Leiden, the Netherlands). They were compared with specimens held in the herbarium of Michigan State University (MSC). Apothecial characteristics were examined by light microscopy on hand-cut sections mounted in water, 10% KOH (K), 50% HNO₃ (N), 15% HCl (H) or Lugol’s reagent (0·15% aqueous IKI). The ascus structure was studied in IKI, both without and after pretreatment with K. Measurements of ascospores and paraphyses were made in K. Ascospore measurements are given in the format (lowest observed – arithmetic mean ± standard deviation – highest observed). Mean values are presented in bold.

The Species

*Lecidea phaeophysata* Fryday, van den Boom & M. Brand sp. nov.

Mycobank No.: MB 828933

Characterized by the *Porpidia*-type asci, narrow ellipsoid ascospores and simple paraphyses with the upper 10–25 μm pigmented.

Type: Italy, Liguria, Sestri Levante, S. Anna, c. 0·2 km from sea, near path to Roman bridges, 44°17′N, 9°22′E, 10 m, sandstone, of steep side (sic), in open Pinus woodland, 21 July 1993, *M. Brand* 30100 (L—holotype; hb. Brand, hb. v. d. Boom—isotypes).

(Fig. 1)

*Thallus* effuse, up to 5 cm diam., chasmo-lithic or thin diffuse, pale greenish when
fresh, creamish to brown in the herbarium; medulla I–. Photobiont chlorococcoid; cells 9–12 μm diam.

*Apothecia* (Fig. 1A–C) abundant, sessile, lecideine, c. 0·6–1·1 mm diam., black with plane, matt disc and slightly raised shiny margin, constricted below, especially in mature apothecia; proper margin 0·07–0·10 mm wide, prominent when young, occasionally becoming excluded in old apothecia. Only fuscous brown pigments present internally (Fig. 1D); pigmentation little changed in K or N although slightly paler in K and more orange-brown in N. *Excipulum* (Fig. 1E) well developed, c. 60–70 μm wide, cupular, continuous below the hypothecium, composed of parallel, radiating hyphae c. 5–6 μm wide with brown extracellular granules; cortical cells 7–10 μm diam. *Hymenium* 55–65 μm tall, paraphyses (Fig. 1F) c. 2·0–2·5 μm wide at the base and apex, thinning somewhat to c. 1·5–2·0 μm wide in middle of hymenium, unbranched, septate, cells c. 10 μm long, occasionally constricted at the septum, not capitulate or strongly conglutinated, upper 10–25 μm pigmented fuscous brown, pigment sometimes extending all the way down to the hypothecium. *Asci* cylindrical, 35–50 × 10–12 μm, *Porpidia*-type (Fig. 1G, H), amyloid tube not reaching all the way to the apex in immature ascii (Fig. 1G). *Ascospores* hyaline, ellipsoid, (11–)14·33 ± 1·67(–)18 × (4·0–)4·79 ± 0·50(–)5·5 μm (n = 12), perispore absent. *Hypothecium* brown, c. 100 μm tall; dark below composed of randomly-orientated hyphae, becoming paler with increasingly vertically-orientated hyphae towards the hymenium; hyphal pigment the same as that of the upper paraphyses.

*Conidiomata* uncommon, seen on only one collection (*Brand* 38356), flat, brown, 0·6–0·8 mm diam., sometimes with a gaping ostiole; conidia filiform, curved c. 14–16 × 0·5–0·6 μm.

*Chemistry.* K–, C–, KC–, Pd–, UV+ yellow (?carotenoids); thallus too scant for TLC.

*Etymology.* The name is derived from the dark pigmentation of the upper part of the paraphyses.

**Distribution and ecology.** The new species is widely distributed on the Atlantic coast of Western Europe from Ireland to Portugal, with one locality in Southern Europe on the Mediterranean coast in NW Italy (Fig. 2). It is found on siliceous rock in maritime areas mainly on or near the coast, on N-sloping overhanging acidic rocks, with only the Irish collection (*Brand* 40679) being more than 2 km from the sea, on an overhang near the entrance of a cave. The type specimen locality is situated on steep sandstone. In other areas it has possibly been overlooked, being mistaken for a species of *Porpidia* or other leci-deoid species. However, it can be distinguished from these in the field by its apothecia having a narrow base which leaves the margins and much of the underside free of the substratum.

No other lichens are present on the type collection but there are saxicolous species associated with the other collections including: *Micarea botryoides* (Nyl.) Coppins, *Micarea prasina* Fr. s. lat. and *Gyrographa gyrocarpa* (Flotow) Ertz & Tehler (Ireland); and *Amandinea pelidna* (Ach.) Fryday & L. Arcadia, *Clistostomum tenerum* (Nyl.) Coppins & S. Elkan, *Divina* cf. *fallax* De Not., *Lecanora praeposteria* Nyl., *L. subcarnea* (Lilj.) Ach. and *Roccellographe circumscripta* (Taylor) Ertz & Tehler (France). The collection from Portugal is from the small rocky hill of Sao Bartolomeu, where van den Boom (2006) recorded 228 species on a wide range of substrata, including acidic rock.

FIG. 1. *Lecidea phaeophysata* (Brand 30100—holotype). A, general view of thallus and apothecia; B, immature apothecia; C, mature apothecia; D, section through apothecium (in H$_2$O); E, section through exciple (in H$_2$O); F, paraphyses (in H$_2$O); G, immature ascus (in IKI); H, mature ascus (in H$_2$O). Scales: A–C = 1 mm; D = 100 μm; E = 20 μm; F–H = 10 μm. In colour online.
Discussion

The combination of *Porpidia*-type asci and simple, non-captitate paraphyses with the upper section having a fuscous brown pigment appear to be unique to the new species. The *Porpidia*-type asci suggest a placement in the *Lecideaceae* but *Lecidea phaeophysata* does not fit comfortably in any described genus of that family. Clearly it does not belong to *Lecidea* Ach. s. str. because of the ascus type, and the genus *Porpidia* Körb. differs in having richly branched and anastomosing paraphyses; *Farnoldia* Hertel also differs in its carbonaceous exciple and capitate paraphyses. *Bryobilimbia* Fryday et al., which also has *Porpidia*-type asci and ± simple, non-capitate paraphyses, is superficially similar and we initially planned to describe our new species in that genus. However, closer inspection revealed a number of significant differences between our new species and species of that genus. In particular, the epihymenial region of the paraphyses of *Bryobilimbia* is dilute brown or unpigmented which contrasts strongly with the pigmentation of the paraphyses in *L. phaeophysata* that regularly extends 10–25 μm into the hymenium, and often the entire length of the paraphysis through to the hypothecium is pigmented (Fig. 1F). In addition, the exciple of *Bryobilimbia* species is less strongly pigmented than the hypothecium and the excipular hyphae are much wider (6–10 μm) than those of *L. phaeophysata*. The pigment present in the exciple and hypothecium of *Bryobilimbia* species is reddish brown and K+ orange (?Superba-brown) and is clearly different from the fuscous brown pigment in our new species. The only Northern Hemisphere species of *Bryobilimbia* that commonly

Fig. 2. Map of Europe showing localities of collections of *Lecidea phaeophysata*. 
occurs on rocks, B. ahlesii (Körb.) Fryday et al., is readily distinguished from the new species, even in the field, by its brown apothecial disc (especially when wet), a consequence of the dilute brown or unpigmented epihymenium, and is further distinguished microscopically by its broader ascospores ((5–)6–7–(9) μm; Aptroot et al. 2009). Also similar to L. phaeophysata is Clausadea Hafellner & Bell., but species of that genus occur on limestone, have branched and anastomosing paraphyses and the same reddish brown (K+ orange-brown) pigment as Bryobilimbia. Other genera with Porpidia-type asci that are similar to Bryobilimbia (Lecidea berengeriana group, Lecidoma Gotth. et al., Romjularia Timdal) are all terricolous or bryicolous species and also differ in the pigmentation of their paraphyses (Fryday et al. 2014).

In the key to lichens of siliceous rocky shores (Fletcher 1975), Lecidea phaeophysata would key out as Porpidia crustulata (Ach.) Hertel & Knoph but it differs from that species, macroscopically, by the larger apothecia (typically 0·3–0·8 mm diam. in P. crustulata; Fryday et al. 2009) with a constricted base and, microscopically, by the simple paraphyses with pigmented upper section and the fuscous brown rather than red-brown pigment.

Between 1875 and 1878, Charles Larbalestier collected lichens extensively in Connemara (Mitchell 1998), including the area where one of the collections of L. phaeophysata (Brand 40679) was made. Nylander described numerous new species of Lecidea from these collections (see References in Mitchell (1998)) but perusal of 18 of these publications (including 10 containing species collected by Larbalestier and others containing species collected by Carroll or Hitchins) revealed nothing that could be an earlier name for L. phaeophysata. Nylander had a very wide concept of Lecidea that included species with septate spores and many of these taxa are now referred to other genera (e.g. Bacidia, Buellia, Catillaria, Lecania, Micarea, etc.) whereas others had already been reduced to synonymy with different species or the descriptions included characters (e.g. hyaline hypothecium, smaller or larger ascospores) that were incompatible with L. phaeophysata. The only species that could possibly have been an earlier name for L. phaeophysata was L. valentior Nyl., but that name has already been shown to be a synonym of Bryobilimbia ahlesii (Meyer 2002). The lectotype of L. valentior in H-Nyl was checked and this determination found to be correct.

The pigment present in L. phaeophysata appears most similar to Arnoldiana-brown (Meyer & Printzen 2000) but that pigment is reddish brown in water and changes between reddish brown at low pH and dark brown at high pH after pretreatment with either K or N. The pigment in L. phaeophysata is fuscous brown in water and changes little at low pH and high pH after pretreatment with K (somewhat lighter at low pH), although it does also change between reddish brown at low pH and dark brown at high pH after pretreatment with N.

Keys to saxicolous lecideoid lichens present on European Atlantic coasts

To aid identification of our new species and assist in separating it from other lecideoid species, we are providing keys to lichens that occur in the same or similar habitat. These keys include those lichen taxa with lecideine apothecia and either simple or septate spores, but exclude species of Teloschistaceae.

The decision as to which species to include was based on those species included in the keys of Fletcher (1975) and on our own field experience. Measurements of apothecia, ascospores etc. are mostly taken from Smith et al. (2009).

<table>
<thead>
<tr>
<th>Ascospores simple</th>
<th>Ascospores septate</th>
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<td>Key A</td>
<td>Key B</td>
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**Key A: saxicolous species with non-septate ascospores**

1. Thallus C+ red (gyrophoric acid) or C+ orange (xanthones) ........................................... 2  
   Thallus C− ........................................................................................................................................... 11

2(1). Thallus C+ red, white, light to dark grey, or brown ................................................................. 3  
   Thallus C+ orange, yellow-green (*Lecidella* spp.) ................................................................. 9

3(2). Apothecia black ................................................................................................................... 4
   Apothecia brown (*Trapelia* and *Trapeliopsis* spp.) ........................................................... 7

4(3). Thallus shiny, with an epinecral layer; apothecia adnate to sessile; paraphyses ± simple .................................................................................................................. 5
   Thallus matt, without an epinecral layer; apothecia innate; paraphyses branched and anastomosing .................................................................................................................. 6

5(4). Thallus grey .................................................................................................................................  Lecidea grisella
   Thallus brown .................................................................................................................................  Lecidea fuscoatra

6(4). Thallus white; cephalodia present .......................................................................................  Amygdalaria pelobotryon
   Thallus dark grey; cephalodia absent ....................................................................................... Schaereria fuscoincerea

7(3). Thallus thin, continuous ........................................................................................................  Trapelia coarctata*
   Thallus thicker, placodioid or subsquamulose ........................................................................ 8

* The genus *Trapelia* in Europe was recently revised (Orange 2018) but as the distributions of the species segregated in that work are currently unclear, we treat only the species in their traditional circumscription.

8(7). Thallus white, placodioid, usually terricolous; apothecia rare ..................................................  Trapeliopsis wallrothii
   Thallus brown-grey, subsquamulose, usually saxicolous; apothecia frequent; ascospores 15–26 × 7–12 μm .................................................................  Trapelia glebulosa

9(2). Thallus sorediate ....................................................................................................................... Lecidella scabra
   Thallus not sorediate ..................................................................................................................... 10

10(9). Thallus of corticate granules ................................................................................................. Lecidella asema
   Thallus of blastidia ....................................................................................................................... Lecidella meiococca

11(1). Thallus K+ red or Pd+ red or yellow ..................................................................................... 12
   Thallus K+ yellow or K−, Pd− ......................................................................................................... 15

12(11). Thallus K+ red (red crystals in section; norstictic acid) ......................................................... 13
   Thallus K−, Pd+ bright yellow or red ............................................................................................. 14

13(12). Apothecia ± pruinose; paraphyses simple; ascospores non-halonate ....................................  Lecidea lactea
   Apothecia pruinose; paraphyses branched and anastomosing; ascospores halonate ................. Porpidia platycarpoides

14(12). Thallus shades of brown, Pd+ red (fumarprotocetraric acid); apothecia brown, sessile; ascospores bean-shaped ......................................................... Fuscidea cyathoides
   Thallus white, Pd+ bright yellow (psoromic acid); apothecia black, ± immersed; ascospores ellipsoid ................................................................. Lecidea phaeops

15(11). Thallus rust red .....................................................................................................................  Lecidea phaeops
   Thallus white or grey or green, if reddish only patchily due to oxidization .......................... 17
16(15) Thallus composed of bullate areoles; apothecia becoming sessile. **Lecidea silacea**  
Thallus of flat areoles; apothecia innate. **Tremolecia atrata**

17(15) Medulla I+ violet. 18  
Medulla I−. 22

18(17) Thallus with tuberculate soralia. **Porpidia tuberculosa**  
Thallus lacking soralia. 19

19(18) Ascospores narrow ellipsoid, <4 μm wide. 20  
Ascospores broad ellipsoid, >5 μm wide. 21

20(19) Exciple C+ red (2′-O-methylanziaic acid). **Lecidea diducens**  
Exciple C−. **Lecidea auriculata**

21(19) Apothecia innate; paraphyses branched and anastomosing; confluent acid present (K+ oil droplets in section). **Porpidia speirea**  
Apothecia sessile; paraphyses simple; stictic acid present (K+ yellow solution in section). **Lecidea lapicida**

22(17) Asci multi-spored, >100 ascospores per ascus; apothecia red-brown, blue-grey pruinose. **Sarcogyne regularis**  
Ascospores 8 per ascus. 23

23(22) Epihymenium K+ crimson; apothecia orange or red (Protoblastenia sp.); on calcareous rocks. 24  
Epihymenium not K+ crimson; apothecia black or brown; on calcareous or acidic rocks. 26

24(23) Thallus distinctly epilithic, often cracked. **Protoblastenia rupestris**  
Thallus endolithic to weakly epilithic. 25

25(24) Apothecia immersed to semi-immersed in the rock, small, 0·2–0·5 mm, concave, plane or weakly convex. **Protoblastenia incrustans**  
Apothecia sessile, large, 0·4–1·6 mm, convex to strongly convex. **Protoblastenia calva**

26(23) Apothecia rare; pycnidia frequent. 27  
Apothecia frequent. 28

27(26) Pycnidia stalked; over bryophytes in shaded areas. **Micarea botryoides**  
Pycnidia sessile; on rock. **Herteliana gagei**

28(26) Thallus composed of green goniocysts. **Micarea prasina**  
Thallus not composed of green goniocysts. 29

29(28) Paraphyses lax in K (Lecidella spp.). 30  
Paraphyses ± conglutinate. 31

30(29) Hypothecium brown; thallus well developed, white. **Lecidella carpathica**  
Hypothecium hyaline; thallus poorly developed or endolithic, greyish. **Lecidella stigmatea**

31(29) Ascospores large, >70 μm long, < 8 per ascus; red pigment present below apothecia. **Mycoblastus sanguinarius**  
Ascospores smaller, 8 per ascus; red pigment absent. 32

32(31) Hypothecium hyaline. 33  
Hypothecium pigmented. 36
33(32) Thallus whitish .......................................................... 34
Thallus dark grey or greenish yellow ........................................ 35

34(33) Apothecia angular with thin proper margin; paraphyses ±simple
........................................................................... Lecidea lithophila
Apothecia rounded with thicker proper margin; paraphyses branched
........................................................................... Miriquidica leucophae

35(33) Thallus dark grey ................................................. Fuscidea lygaea
Thallus greenish yellow ............................................. Lecanora sulphurea

36(32) Hymenium with red, K+ purple pigment .............. Lecidea sarcogynoides
Hymenium ±hyaline ................................................... 37

37(36) Apothecia <0.5 mm, hymenium <50 μm (Micarea spp.) ........................................ 38
Apothecia >0.5 mm, hymenium >50 μm ........................................ 39

38(37) Thallus epilithic, grey; apothecia usually with distinct proper margin
........................................................................... Micarea erratica
Thallus ± endolithic; apothecia globose, proper margin ±absent .... Micarea lutulata

39(37) Paraphyses simple, upper 20 μm pigmented ............ Lecidea phaeophysata
Paraphyses branched and anastomosing ..................................... 40

40(39) On ±calcareous substrata; hypothecium paler than exciple, only brown pigments
internally ......................................................................................................................... 41
On siliceous substrata; hypothecium and exciple concolorous, greenish pigments
often present internally (Porpidia spp.) .................................................. 43

41(40) Apothecia immersed in the substratum .................... Clauzadea metzleri
Apothecia sessile ........................................................................... 42

42(41) Hymenium usually with violet (K+ blue) granules; ascospores often 1-septate ....
........................................................................... Bryobilimbia hypnorum
Hymenium lacking violet (K+ blue) granules; ascospores never septate
........................................................................... Clauzadea monticola

43(40) Exciple with hyaline medulla, excipular hyphae 2–3 μm wide ......................... 44
Exciple pigmented throughout, excipular hyphae wider ..................... 45

44(43) Epihymenium bright blue; thallus lacking lichen substances; not sorediate ........
........................................................................... Porpidia hydrophila
Epihymenium olivaceous or brown; thallus containing 2′-O-methylsuperphyllinic
acid; often sorediate .................................................. Porpidia rugosa

45(43) Exciple medulla pale brown, less pigmented than cortex; paraphyses richly branched
and anastomosing; stictic acid or no substances present .................... 46
Exciple ±uniformly dark; paraphyses sparingly branched and anastomosing;
confluent acid or methyl 2-O-methylmicrophillinate present ............ 47

46(45) Proper margin thin and barely raised, <0.08 mm wide; mature apothecia <1.5 mm
diam.; thallus epilithic, thin ................................................. Porpidia crustulata
Proper margin thick and raised, >0.1 mm wide; mature apothecia >1.5 mm diam.;
exciple pale to mid brown internally; thallus ± endolithic .................... Porpidia macrocarpa
47(45) Thallus containing conflucent acid (K+ oil droplets in section) ................................. Porpidia cinereatra

Thallus containing methyl 2′-O-methylmicrophillinate (K−) ............................... 48

48(47) Apothecia innate ...................................................................................... Porpidia contraponenda

Apothecia sessile ......................................................................................... Porpidia irrigua

**Key B: saxicolous species with septate ascospores and brown to black apothecia**

1  Ascospores hyaline ......................................................................................... 2
    Ascospores brown ........................................................................................ 22

2(1) Ascospores 1-septate .................................................................................. 3
    Ascospores 3- or more septate or muriform .............................................. 11

3(2) Apothecia marginate, sessile ..................................................................... 4
    Apothecia immarginate, immersed ......................................................... Arthonia meridionalis

4(3) Medulla I+ violet ....................................................................................... 5
    Medulla I− ................................................................................................. 6

5(4) Thallus brown with a grey-violet tinge, C+ red; apothecia up to 1 mm diam.;
    ephyrennum K− ................................................................. Rhizocarpon richardii

Thallus dark brown with a faint grey or pink tinge, C−; apothecia up to 0·7 mm diam.;
    ephyrennum K+ purple-red .......... Rhizocarpon polycarpum

6(4) Apothecia 0·4–0·8 mm diam. ...................................................................... 7
    Apothecia 0·2–0·4 mm diam. .................................................................... 8

7(6) Thallus epilithic on siliceous rock; ascospores elongate-ellipsoid, 10–15 × 3–5 μm;
    hypothecium pale .......................................................... Tylothallia biformigera

Thallus endolithic on limestone; ascospores ellipsoid, 9·5–12·5 × 4·0–5·5 μm;
    hypothecium reddish brown .................. Toninia athallina

8(6) Hypothecium hyaline ............................................................................... 9
    Hypothecium dark brown .................................................................... 10

9(8) Apothecia 0·1–0·2 mm diam., excipulum green-black throughout; on siliceous rock
    .......................................................... Catillaria atomarioides

Apothecia 0·1–0·4 mm diam., excipulum pale at inner part; on limestone ................
    .......................................................... Catillaria lenticularis

10(8) Ascospores (7·5–9·0·9·0–12·0(−15·0) × 2·5–4·0 μm .................. Catillaria chalybeia

Ascospores 15–18 × 7·0–8·5 μm ........................................ Rhizocarpon infernulum

11(2) Ascospores with only transverse septa ................................................... 12
    Ascospores muriform ............................................................................. 21

12(11) Ascospores 10–17-septate, 60–95 × 3–4 μm ............... Bactrospora patellarioides

Ascospores 3–7-septate; <60 μm long .................................................. 13

13(12) Apothecia marginate; ascospores 3-septate; thallus pale grey to pale brown,
    squamulose .......................................................... Toniniopsis aromatica

Apothecia immarginate or margin soon excluded; ascospores 3–7-septate .......... 14

14(13) Apothecia immarginate; ascospores 3–5-septate; thallus brown with faint mauve tinge...
    ........................................................................ Arthonia phaeobae
Apothecia margin present in young apothecia but soon excluded; thallus without faint mauve tinge

15(14) Ascospores 3-septate; thallus crustose .................................................. **Toniniopsis mesoidea**

16(15) Apothecia brown ..................................................................................... 17

18(17) Thallus irregularly granular-warted; apothecia common; ascospores 1–3(–5)-septate, narrowly fusiform, 14–28 × 2–3 μm ............................. **Lecania cuprea**

19(16) Thallus black, minutely squamulose; prothallus dark bluish to black; ascospores 1–3-septate .......................................................... **Placynthium nigrum**

20(19) Thallus yellow-brown, C+ orange; paraphyses ± conglutinated .......................... **Toninia thiopsora**

21(11) Thallus white; apothecia up to 1 mm diam.; epihymenium olive brown; ascospores usually >35 μm long ............................................. **Rhizocarpon petraeum**

22(1) Thallus placodioid with marginal lobes 0.5–1.0 mm wide ............................. 23

23(22) Thallus with small marginal lobes, up to 0.5 mm wide; apothecia immersed, often with a white pruina; ascospores rugulate, 8–12 × 5–8 μm ................................................................. **Dimelaena radiata**

24(22) Ascospores submuriform to muriiform .................................................. 25

25(24) Thallus green; ascospores muriform .................................................. **Rhizocarpon geographicum**

26(25) Thallus K+ red (red crystals in section) ............................................ **Diplotomma chlorophaeum**

27(24) Ascospores double-walled, walls variously thickened .......................... 28

28(27) Ascospores *Physconia*-type ................................................................. 29

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29(28) Thallus rimose, whitish to brown; ascospores 10–15 × 6·5–8·5 μm .......................... Amandinea pelidna
Thallus areolate to bullate to bullate-subsquamous .............................. 30

30(29) Conidia filiform, 15–30 μm long; thallus areolate to bullate, pale to dark brown......
.......................... Amandinea coniops
Conidia bacilliform, 5–6 μm long; thallus flat, bullate to bullate-subsquamous, 
whitish to ochraceous ................................. Buellia dispersa

31(28) Ascospores Mischoblastia-type ........................................ Rinodina oxydata
Ascospores of different type ...................................................... 32

32(31) Thallus C+ red; ascospores between Physcia and Milvina-type .......................... Rinodina luridescens
Thallus C−; ascospores Pachysporaria-type .... Rinodina beccariana var. lavicola

33(27) Apothecia immersed .............................................................. 34
Apothecia adnate to sessile .......................................................... 35

34(33) Thallus K+ red (norstictic acid); ascospores 12–18 × 6–10(–12) μm .................... Buellia aethalea
Thallus K+ yellow (atranorin); ascospores 10–13 × 5·0–7·0(–8·5) μm ................ Buellia stellulata

35(33) Thallus K+ red, C+ red or C+ orange ................................................. 36
Thallus K− or K+ yellow and C− .................................................. 39

36(35) Thallus K+ red (norstictic acid) ................................................... 37
Thallus K− or K+ yellow (different chemistry) ...................................... 38

37(36) Thallus containing xanthones (UV+ orange); conidia 6–7 × 1·0–1·2 μm ................ Buellia indissimilis
Thallus without xanthones (UV−, but with atranorin); conidia 9–13 × 0·8–1·0 μm ...
...... Buellia subdisciformis

38(36) Thallus rimose cracked, yellow-grey, C+ red, UV− (gyrophoric acid) ................ Buellia saxorum
Thallus areolate, white to pale yellow-grey, C+ orange, UV+ orange (xanthones) ...
.................................................. Buellia ocellata

39(35) Hymenium inspersed with oil droplets .................................. Buellia leptoclinoides
Hymenium clear ........................................................................ 40

40(39) Thallus delimited by a dark fimbriate prothallus, K+ sordid yellow-brown,
KC+ brownish orange or KC+ briefly pinkish ...................................... Buellia tesserata
Thallus not delimited by a dark fimbriate prothallus; thalline reactions different ... 41

41(40) Conidia bacilliform, up to 8 μm long .............................................. Amandinea punctata
Conidia filiform, up to 30 μm long ................................................ Amandinea punctata

42(41) Thallus forming rosettes, well delimited by a pale prothallus; apothecia adnate, rarely sessile, 
up to 0·5 mm diam; conidia 2·5–4·0 × 1·0–1·5 μm . Buellia caloplacivorah
Thallus not forming rosettes; apothecia cryptolecanorine to adnate, up to 0·7 mm 
diam.; conidia 4–6 × 1 μm ........................................ Buellia spuria
We are grateful to Maarten Brand for the loan of his specimens, and also thank Måns Svensson (UPS) for checking the identity of the lectotype of *Lecidea valentior*.

**REFERENCES**


